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## IV&V Facility Effectiveness Metrics Plan

**Purpose:** The purpose this document is to enable the IV&V Facility to measure and improve the effectiveness of its practices in meeting the overall objectives of IV&V. Specifically, this document will:

- Define IV&V Effectiveness
- Layout general objectives for the effectiveness metrics effort
- Layout a schedule for achieving the general objectives of this effort
- Provide IV&V Facility Civil Servants and contractors with a high level plan to allow them to access how they fit into the equation and to plan their work.
- Initiate metrics collection at the IV&V Facility.

**Objectives of IV&V:** The following are the overall objectives to be satisfied by IV&V.

- Provide the assurance that a system will be fit for operation and meet mission requirements for safety, availability, quality and function.
- Provide early life cycle detection of errors/issues/risks in the project so that appropriate corrective actions can be taken to minimize system wide impacts.

**Definitions of IV&V Effectiveness:** IV&V effectiveness is the measure of how well the IV&V Facility meets the above objectives.

In terms of the first objective, effectiveness is the measure of the change in the level of mission assurance resulting from the software IV&V. Mission assurance is not an ordinal number that can be quantified. For example, no one can say that the mission assurance as of today is 85%. Hence we (the IV&V Facility) can't measure absolute change in mission assurance over time. However; we can document and assess the value of improvements in safety, availability, quality, and functionality resulting from IV&V. Improvements in safety, availability, quality, and functionality are considered evidence of IV&V effectiveness in that they demonstrate that mission assurance has improved. Conversely, if safety, availability, quality, and functionality issues slipped through IV&V and were later found in system testing or operations; this would be evidence that IV&V was not as effective as it should have been.

In terms of the second objective, IV&V effectiveness is the measure of when a given problem was found by IV&V in relation to when the problem was introduced and when the problem would likely have been found if IV&V had not

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been employed. Finding problems early in development reduces the cost of fixing them and gives developers more time to make corrections.

**Objectives of IV&V Effectiveness Metrics:** Simply measuring IV&V effectiveness as defined above would provide a “snap shot” of IV&V effectiveness, but would not provide the information needed for process improvement. To improve IV&V effectiveness, we must measure IV&V in the context of factors we have the ability to influence. These factors include, but are not limited to, resources applied to the IV&V, characteristics of the software development project undergoing IV&V, and characteristics of the IV&V itself. The following goals and questions must be addressed:

**Goal 1 >** Maximize IV&V benefits to NASA by selecting projects where we can have the greatest impact.

**Question 1.1 >** What is the IV&V effectiveness for each project?

**Question 1.2 >** What characteristics of the a software development project impact IV&V effectiveness?

**Goal 2 >** Maximize IV&V benefits as a function of resources available.

**Question 2.1 >** What is the relationship between resources available and IV&V effectiveness.

**Question 2.2 >** For a given software development project, what is the relationship between IV&V characteristics and IV&V effectiveness?

## **Definitions:**

**Software Development Projects Characteristics >** These may include the type of mission, the principle function of the software, the software development model, the process maturity of the developer, the timing of the IV&V in relation to the development, the availability of artifacts, etc.

**IV&V Characteristics >** An IV&V is characterized by the tasks and resources applied to the IV&V. To the greatest extent practical, tasks definitions must be standardized across the IV&V Facility. We understand that tasks may be planned in advance or may be implemented in response to finding from the performance of another task. Hence, a task may be a parent or child of one or more other tasks. Resources consist of people, facilities (testbeds etc.), and tools applied to an IV&V. People must be characterized by level of experience and applicable areas of expertise.

**Indicator >** In one version of the Goal-Question-Metric (GQM) Paradigm, an indicator is number or a chart which answers a question. Light-weight indicators

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developed in the early phases of this effort may or may not completely answer the corresponding questions.

**Schedule and Implementation:** This plan will be implemented in phases.

Phase I (First 4 months after this plan is approved by the government.)

- IV&V services contractor review this plan and determine the resources required to support Phase I.
- Government implements task orders as required to support this effort.
- Each IV&V services contractor reviews their processes to identify where relevant data may exist.
- Based on data already being generated, each IV&V services contractors develop a set of light-weight indicators in response to Questions 1.1 through 2.2 above.
- Each IV&V services contractor will select two on going IV&V projects as pilot projects.
- The IV&V services contractors will initiate a 4-month trail effort to collect metrics and populate the indicators for the pilot projects.
- The contractors will track the resources required to collect and analyze metrics from the pilot projects.
- Based on their own experience, each IV&V services contractor will compile a list of software project characteristics necessary to describe a given project.
- The services contractors will use their list to characterize each software development project currently in IV&V.
- Based on their own experience, each IV&V services contractor will compile a list of IV&V characteristics necessary to describe a given IV&V.
- The services contractors will use their list to characterize each on-going IV&Vs.
- The IV&V services contractors will review potential IV&V effectiveness models to include the Titan Return on Investment (ROI) Study by Jim Dabney, the Advance Risk Reduction Tool (ARRT) by Martin Feather, the optimization environment being developed by David Raffo, simple phase containment, and other models they may deem appropriate.
- Each IV&V services contractor will prepare a white paper of no more than 5 pages detailing the strengths and weakness of each model and the projected level of effort to needed to implement each model across all IV&Vs.
- Prepare a cost estimate for Phase II.
- Present all finding from Phase I

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Phase II (Months 5 - 9 after this plan is approved by the government.)

- IV&V services contractors will refine the light-weight indicators developed in Phase I
- If needed, the contractors can recommend minor IV&V process changes to allow incremental improvement to the data collected and the indicators developed in Phase I. This may include modifications to PITS, other facility databases, or monthly report formats.
- If PITS need to be modified, Mountain State Information Systems (MSIS) may do it under their existing research initiative.
- IV&V service contractor will expand their metric collection and analysis effort from the four pilot projects to all IV&Vs.
- Contractors will meet with the government to standardize their lists of software development and IV&V characteristics into a single list to be used by the entire Facility.
- If MSIS receives DDF to build a common data dictionary, they will incorporate the standardized list and associated definitions into their product.
- After careful consideration of contractor input, the government will select one or more model based metrics approach. The same approach or approaches will be used by all IV&V services contractors.
- The contractors will prepare a concept of operations for the selected model based approaches. The document will cover, what data will be collected, who will collect them and when, processes for data collection and analysis.
- Prepare a cost estimate for Phase III.
- Present all finding from Phase II

Phase III (Fully implemented within 12 months after approval of this plan.)

- Continue to collected data from all IV&Vs to populate the light-weight indicators initiated in Phase I.
- Implement the concept of operations developed in Phase II.
- Re-evaluate the metrics collection and analysis effort every 6 months determine if it is still providing value.